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ESSENTIAL OIL FROM MEDANG LESOH *(CINNAMOMUM PARTHENOXYLON).*

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A sample of oil from Medang Lesoh was received from the Forest Research Officer, F.M.S.

Description of Sample.—The sample consisted of an orange yellow coloured oil, having an odour of safrol. The oil when received was slightly cloudy, due to occlusion of water but, on filtration through a dry filter paper, a clear bright oil was obtained. (Note: Owing to the colder climate in England more moisture settled out, causing the filtered oil to become cloudy).

Results of Examination.—A chemical and physical examination of the sample gave results shown in the table below. For comparison, results obtained previously in Java (quoted in "The Volatile Oils' by Gildemeister and Hoffmann Vol. II p442) and also results obtained at the Imperial Institute on two samples (A) original oil and (B) oil redistilled in steam in glass apparatus at the Department of Agriculture, F.M.S. and S.S. (Vide Bulletin Imperial Institute Vol. XXIII No. 4,1925 p428) are included.

	Dept. of Agriculture F.M.S & S.S.	Imperial Institute		Java Oils.
		Sample A.	Sample B.	
Specific Gravity at 15.5°C/15.5°C	1.101	1.103	1.103	1.067–1.080
Optical Rotation ^{a}D	nil.	nil.	nil.	+1°3′–1°22′
Refractive Index $^{N}D20°$	1.538	1.538	1.538	1.532
Ester Value before Acetylation	2.5	0.8	—	—
Ester Value after Acetylation	8.4	3.5	—	11.8
Congealing Point	—	10°C	10.5°C	—
Solubility in 90 per cent alcohol at 15°C	Sol. in 3.3 Vols (at 29°C)	Sol. in 3.5 Vols.	—	—

Note.—The Specific gravities of samples A & B sent to the Imperial Institute, as determined by us, were 1.107 and 1.105 respectively at 15.5°C. These represent a second consignment from the Forest Department.

Distillation of Oil—On direct distillation at atmospheric pressure the following results were obtained.:—

Department of Agriculture.	Imperial Institute.
Fraction boiling at 229°–238°C =96.0 per cent.	Fraction boiling at 234°–237°C =91 per cent.
Residue =4.0 per cent.	Fraction boiling at 237°–239°C =5 per cent.
	Residue =4 per cent.

Steam distillation of original oil.—Sample B, sent to the Imperial Institute, was obtained by steam distillation of the original oil in glass apparatus in the laboratory and represents 96 per cent of the original oil.

Distillation of Roots:—A sample of the roots of the tree from which the oil is obtained was also received from the Forest Department and, after being cut into chips, was distilled in the laboratories, yielding 3.0 per cent of oil on the fresh material. The oil distilled from a copper still with a block tin condensing coil is almost water white.

Chinese distillation method.—The original oil was obtained from the roots by a Chinese distiller, using a still and condenser similar to that adopted by Chinese and Japanese for the distillation of camphor wood (*Cinnamomum Camphora*). The still consists of a wooden cone-shaped vessel (with the top cut off) resting on an iron pan or vessel containing water to provide steam for the distillation. A direct fire is used under the iron vessel. The wooden cone-shaped still is filled with chips of the root. A grid, between the cone and the pan containing the water, supports the chips and enables the steam to pass through the wood. The open top of the cone-shaped still is closed with a wooden cover, luted on with clay during distillation. The base of the still is also similarly luted to the iron pan containing water, during distillation. A hollow bamboo luted into a hole near the top of the still conducts the steam and oil vapour to a wooden tank or tub containing clay at the bottom and water. This forms the condenser, the clay and water act as a seal at the bottom of the barrel. If necessary, a second and third similar condenser, connected in series with the first by means of hollow bamboos, are also added. A hollow bamboo to act as a chimney or escape is fixed in the top of the last condenser. The oil collects in the condensing barrels and can be separated from the water.

Remarks and Conclusions.—The results obtained at the Imperial Institute and by us are very similar and show that the oil consists principally of safrol, as was anticipated. Its value on the European market is not high.

In the opinion of a firm of soap makers, to whom a sample of the oil was submitted by the Imperial Institute, the oil would probably not fetch more than 1/3 per lb. in competition with safrol which (in Oct. 1925) was worth 1/6 per lb.

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EXPERIMENTS ON THE GERMINATION OF AFRICAN OIL PALM SEEDS.

E. A. CURTLER.

THE object of this article is to place on record the results obtained by treating seeds of the African Oil Palm (*Elaeis guineensis)* previous to planting them, with a view to increasing and/or expediting the germination. Three separate experiments have been laid down at the Government Experimental Plantation, Serdang, but to date only two of them have been concluded. The results given below can only be taken as an indication of the results that are to be expected as the experiments have not been duplicated and in the second experiment the seeds used had been harvested from young palms which had only been bearing for about six months when the fruits were collected.

(1) SOAKING IN HOT WATER.

The 2,000 seeds used in this experiment were supplied by the Manager, Tennamaram Estate, Batang Berjuntai. One thousand were treated with hot water, the remainder receiving no previous treatment. The method of soaking the seeds was as follows. The seeds were kept in a large tin bucket which they half filled. At the commencement of the experiment the seeds were completely covered with water, hot and cold mixed, till the temperature of the water in bucket was 45° C. = 113° F. On each of the following seven days, hot water was added at 7.15 a.m. and 3.15 p.m. till the temperature had been raised to 45° C. the seeds and water being stirred at the same time to make sure that the temperature was the same throughout. After the first day it was necessary to remove water from the bucket before pouring in the hot water.

On the same day as the one thousand seeds were put to soak, which was six half weeks after the bunch had been cut, the remainder of the seeds were planted in one half of the sand bed. The planting distance was $2\frac{1}{2}$ x $2\frac{1}{2}$ inches square, the top of the seed being about half an inch below the surface of the sand.

At the conclusion of the seven days soaking in water, the seeds were taken from the bucket and planted in the same manner as the control seeds.

The sand bed was examined daily and each seed was recorded as germinated when the tip of the leaf was visible above the sand, the seedling was then dug up and planted out in an ordinary nursery bed.

TABLE 'A'.

——	Control.	Soaked in water.
Period from planting or putting to soak to 1st germination -	51 days.	49 days.
Period from planting or putting to soak to last germination -	184 ,,	184 ,,
Average period of germination -	94 ,,	88 ,,
Germination capacity -	44% ,,	58% ,,

Just east of the seed bed was a small store, so that the soaked seeds which were planted in the western half of the bed had the sun on them a little earlier each morning. The whole bed was kept thoroughly watered during the whole time the experiment was in progress. The average period of germination was calculated from the record of the actual number of seeds which germinated each day.

(2) Soaking in dilute Hydrochloric Acid.

The seeds used for this experiment were taken from selected bunches harvested in the avenue at the Experimental Plantations, Serdang.

At the time of harvesting the palms had been planted out for only two and a half years and had only been in bearing for six months. The bunches had all been cut within one month of the planting of the seeds, the best bunches available were selected and only the good seeds from the bunches were planted.

One thousand seeds were used in the experiment. Half the seeds were soaked in an enamelled vessel, in 1% Hydrochloric acid for seven days and then in water at air temperature for three days The seeds must not be soaked in a metal vessel, as the acid will attack the metal.

On the same day as the seeds were put to soak in the acid, the balance were planted at one end of a sand bed 3 x 2½ inches square, with the top of the seed about half an inch below the surface of the sand.

After the seeds which had been soaked in 1% Hydrochloric acid for seven days had been in water for three days, they were planted in an adjoining part of the sand bed, in same manner as the untreated seeds.

The subsequent treatment was as in the previous experiment.

TABLE B.

——	Control.	Soaked in 1% Hydrochloric acid.
Period from planting or putting to soak to first germination -	72 days.	82 days.
Period from planting or putting to soak to last germination -	327 „	307 „
Average period of germination -	24 weeks.	20 weeks.
Germination capacity -	40%	46%

TABLE C.

Period.	Percentage germinated.	
	Control.	Soaked in 1% Hydrochloric acid.
Less than 3 months -	2	1
„ „ 4 „ -	13	16
„ „ 5 „ -	25	36
„ „ 6 „ -	30	40
„ „ 7 „ -	33	43
„ „ 8 „ -	35	45
„ „ 9 „ -	35	45
„ „ 10 „ -	37	46
„ „ 11 „ -	40	46

Observations.

Consideration of Table A indicates that soaking the seeds of the African Oil Palm in water tends to both improve and expedite the germination.

Consideration of Table B indicates that, with seeds taken from young palms, the effects of soaking in 1% Hydrochloric acid are similar to soaking in water, but the Hydrochloric acid has more effect on the period of germination than on the capacity.

Comparison of Table A and B indicates that young seeds are much slower germinating and that the germination capacity is lower than seeds from older palms. In each experiment the sand bed was kept under observations for three months after the last record had been taken to make sure that the records were complete.

The figures recorded in Table C indicate that, with seeds from young palms, the majority of the seeds germinate within seven

months of planting, although germination may go on till eleven months after planting.

The records, to-date, in the experiment which is not yet complete tend to confirm the results previously obtained by soaking the seed in 1% Hydrochloric acid. They also clearly show that by raising the strength of the Hydrochloric Acid to 5% it very considerably reduces the germination capacity of seeds.

Summary.

1. Two experiments with germination of seeds of African Oil Palm (Elaeis guineensis) are discussed and a third is mentioned.

2. The methods employed in laying out and recording the two experiments are described.

3. The results obtained in the two experiments are tabulated.

4. The results indicated that germination of African Oil Palms seed can be expedited and a higher germination percentage can be obtained by soaking the seeds for one week in warm water or 1% Hydrochloric Acid, and that the majority of seeds from young palms, which will germinate, do so within seven months of planting.

5. A mention is made of an experiment in progress which, up to the present, confirms the result previously obtained with 1% H. Cl and shows that 5% H. Cl is too strong to be beneficial.

HEVEA MILDEW IN CEYLON AND MALAYA.

A. SHARPLES.

THE following article is of interest to Malayan planters in the light of the experience gained by many over the last two years. The article is written by C. H. Gadd, D. Sc., acting Mycologist, and is reprinted from the Year-Book of the Department of Agriculture, Ceylon. 1926.

"Early in 1925, when Hevea trees were forming new leaf after wintering, reports ware received from most of the rubber districts of Ceylon that young leaves, not full grown, were falling to the ground and the trees were being defoliated. The presence of newly fallen leaflets, not yet full grown, amongst the old and withered leaves from the last wintering attracted attention to the fact that something was amiss with the trees, and an examination of leaves disclosed the presence on them of a fungus, a species of *Oidium*."

"The young leaf of Hevea when it first expands from the bud is of a shining, brown or bronze colour. It is when the leaves are at this stage of development that the fungus causes the greatest damage. When attacked, such leaflets become dull and faded, the tips and edges curl downwards or the whole leaflet may become crinkled. A few days later, the leaflets fall off. Usually the leaf does not fall entire; the leaflets are shed in succession leaving the leafstalk attached to the branch for some time. Some of the attacked leaves have superficial, glistening, white, powdery patches of varying size on their upper or lower surfaces. These patches consist of the mycelium and spores of the fungus. Fungi which form white powdery patches are usually termed "mildews" so, the name 'Hevea mildew' may be applied to this fungus."

"If the leaves are older, though still not full-grown, before they are attacked, the defoliation is not so marked. One or two leaflets only may fall, leaving stalks bearing one or two leaflets instead of the usual three. As the leaves become older, they become more resistant and if attacked are able to overcome, to some extent, the effects of the fungus. Fully grown leaves on trees which have been attacked are often peculiarly distorted. Parts of the leaves may be destroyed, particularly the tip, and curious folds or pleats are frequently present. These folds appear to be due to the unequal expansion of the leaflets resulting from the death of some small area, usually near the midrib, consequent to the attack. The occurrence of numerous leafstalks which bear one or two leaflets and those frequently distorted, may be regarded as a characteristic feature of this disease."

"The fungus also attacks the flowers. On these the fungus seems to thrive better than on the leaves, as the young inflorescences are often thickly covered with a downy growth of mycelium and spores. Then, the flowers do not develop and fruit is not formed.

"The ordinary vegetative mycelium consists of numerous, colourless, septate, branched hyphae attached to the surface of the leaves by special organs, known as haustoria, which penetrate the epidermis. The haustoria are also the means by which nutriment is withdrawn from the host. With the exception of the haustoria the fungus is

entirely superficial. Under favourable conditions the mycelium produces special erect, colourless, septate branches up to 46 microns long, 6-8 microns broad. These are known as conidiophores and it is on these that the spores are produced. The spores (conidia) are abstricted from the end of the conidiophores either singly or in short chains of not more than three conidia. The formation of conidia in this way gives a powdery appearance to the mildewed leaves. The *Oidium* on Hevea does not produce spores so abundantly as do the mildews known on other hosts, so that attacked leaves do not all show markedly the powdery character of the disease. The conidia are hyaline, barrel shaped, constricted near the ends, thin walled and measure 30-33 by 12-16 microns; they are rapidly carried by the wind and are capable of immediate germination and growth on reaching a suitable host. The ascospore stage of this fungus, like that of most tropical species of *Oidium*, is unknown."

"Another fungus has been found on many of the older Hevea leaves examined for the presence of *Cidium*. This is a species of *Cicinnobolis* which is parasitic on the *Oidium*. This fungus has oval, usually stalked, brown or yellow-brown, cellular pycnidia, measuring 34-40 by 24-28 microns; the spores are hyaline, oblong oval, 6-8 by 3-4 microns. On such leaves the *Cicinnobolis* is more easily found than the *Oidium;* no doubt this fungus helps to keep the *Oidium* in check."

"Hevea mildew has been known in Java since 1918 and from the account given of the disease there, it would appear that the Ceylon disease is the same."

"It is a point of some importance that the disease in Ceylon occurred almost simultaneously in most of the rubber growing districts at points widely separated. This would indicate that the fungus was already widely distributed here on some unknown host plant, and that it was not a recent introduction from abroad. If recently introduced, the disease would have spread from definite centres, places to which the disease had been brought with introduced plants. Usually, a species of *Oidium* parasitic to plant life is unable to live saprophytically, so that one must look for mildews on other plants, particularly allied plants, as the probable source of infection for Hevea."

"Petch has published (Ann. Perad. VI. pp. 243-4) a list of 31 plants on which species of *Oidium* have been found in Ceylon, and it is possible that the fungus from one or more of these has adapted itself to a new host. When the attack of *Oidium* was first reported on Hevea from Java, he tried to infect Hevea seedlings with the mildews from *Euphorbia hirta* and *Phyllanthus Niruri*, two common weeds belonging to the same natural order as Hevea, but without success. This line of enquiry, however, is worthy of further investigation."

"Normally, at the time when Hevea is putting forth its new leaf, weather conditions in Ceylon are dry, and are not favourable for fungus growth. In 1925, there was more rain and the number of wet days was greater than usual during February and March in the rubber districts, and it is probable that these wetter conditions

favoured the fungus and helped the process of adaptation to its new host. If so, given normal climatic conditions at the time new leaves are next produced, it is unlikely that the trees will be severely attacked, as what infectious material has persisted on the old leaves will be shed with them on wintering. If reinfection then occurs, it must happen under unfavourable conditions and from an external source unless the fungus proves itself able to overwinter on the Hevea twigs. Consequently, given dry climatic conditions at the time of production of new leaves it is not expected that the disease will recur to any serious extent. But as the fungus belongs to a genus which contains a number of very serious diseases a careful watch should be kept for the recurrence of this mildew on Hevea."

The above, with the exception of small matters of detail, typically describes Malayan experience in 1925. In February March and April, 1925, reports of "leaf-fall" from widely separated parts of the peninsula were received. In view of the fears of the possible appearance of "*Phytophthora*" leaf-fall, careful examinations of attacked leaves were made in every case, but the typical *Phytophthora* hyphae were never demonstrated in the attacked tissues. The *Oidium* fungus was absent, the prominent fungus being a species of *Gloeosporium*, probably *G. Albo-rubrum*. In all cases, the attacked portions of the leaves turned black, but there was never any sign of surface mildew, which is the prominent feature in Ceylon.

The sequence of events leading up to the Malayan attacks was a fairly long, dry spell in December, which started the trees off on the annual wintering period some two months earlier than in normal years. Long before the production of new leaves, the rains fell and continued right through the normal months of the wintering period, so that a very uneven wintering resulted. As individual trees, or groups of trees put out new flushes of leaves, these were attacked and the ground under the trees was covered with small, bright-green, young leaves, newly fallen. In some cases, successive defoliations on the same tree took place; in one authentic case, defoliation, with the same symptoms, took place on three occasions.

This year, 1926, wintering was even and normal. Up-to-date not a single case of leaf-fall has been reported this year. Thus Gadd's conclusion can be emphasised. "Consequently, given dry climatic conditions at the time of production of new leaves, it is not expected that the disease will recur to any serious extent."

This is another interesting case of widely differing fungi, in different countries producing similar symptoms on the same crop.

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DISEASES OF THE COCONUT PALM.—(*cont.*)

A. SHARPLES.

IN the last issue of this journal the present-day position of the "Bud-Rot" problem was summarised, special attention being given to the work carried out in India by various workers. This article will deal chiefly with obscure symptoms observed in Malaya which have been confused with "Bud-Rot" by planters. Before doing so, it may be advisable to give prominence to Nowell's work in the West Indies on the disease known as Red-Ring of Coconuts.

The symptoms of Red-Ring disease of Coconuts were first brought to notice in the West Indies in 1905 but it was not till 1918 that Nowell suggested that the Nematode worm usually found associated with the disease was the true cause. This suggestion has been fully confirmed by numerous experiments.

Nowell says * "The failure of the tree is marked by a progressive yellowing and browning of the leaves in the order of age commencing at the tips of each leaf reached in the process. Commonly, the lowest living leaves are the first affected, but occasionally one or several of these may remain green while the discoloration, commencing above them, successively involves the younger leaves. In the early stages the process is indistinguishable by external appearances from the natural dying-off of the old leaves, especially where this is accelerated by drought, water-logging, or poor conditions of growth in general. The difference becomes apparent however from the steady march of the discolorations, which soon begins to involve leaves in full vigour, and continues to those in which the leaflets are not even fully expanded. A tree at this stage is exceedingly conspicuous from its rich coloring of brown orange and yellow, involving all but the central tuft of young leaves. This condition may be reached in three or four weeks from the time of appearance of the symptoms."

"The shedding of green nuts in all stages of immaturity may take place concurrently with or slightly in advance of the discoloration of the leaves and is thus in some cases the first external sign of trouble, though it must be remembered that shedding of small nuts often occurs from healthy trees."

"Secondary infestation of the falling leaves with *Diplodia sp.* results in the development of patches of brown or black rot, wet but firm, in situations on the leaf-stalks, especially towards the base. This appears to be the chief reason for the tendency of the leaves to break across and hang down. Such infestations are common in healthy trees on leaves approaching senility, but have much more scope when the leaves are failing in rapid succession from disease."

"In the final stage of the disease there ensues a bacterial soft rot of the tender tissues forming the apex of the stem, as also of the

* Diseases of Crop Plants in the Lesser Antilles : W. Nowell, D I.C.

similar tissues at the base of the young inflorescences. There is no connection between this and infectious "Bud-Rot" disease; death of the Coconut Palm from widely differing causes is regularly followed by bacterial putrefaction of the enclosed soft tissues of the bud."

"The following description of the internal symptoms applies to trees during the process of failure of the leaves before the secondary rotting of the bud begins. A cross section towards the base of the stem shows a well-marked zone, usually 1—1½ inches wide and beginning 1—2 inches from the periphery, in which the ground tissue is dull-red or red mingled with mustard yellow. A vertical section shows the zone completely surrounding the base of the stem, extending upwards as a solid band of reddened tissue to about half its height, then breaking up into longitudinal streaks and finally into scattered dots about 1 m.m in diameter. In the latter form it extends to the soft meristem underlying the bud, in which region the dots appear generally dispersed below the flattened apex of the stem. *In very exceptional cases the discoloration in the stem as a whole is central.*"

"When the leaves of a tree in this stage are split open in the median line a similar red-spotted or red and yellow streaked discoloration is revealed in the leaf-stalk extending in the fully developed leaves from near the base to a distance of from 6 inches to 2½ feet outwards. In the older leaves it becomes masked by the development of brown rot, or by the natural browning of the tissues. In the leaves of the central column which still remain green, the internal discoloration of the petiole appears with great intensity, and often extends to the undeveloped leaves which they enclose."

"In the oldest leaves the infestation extends to the base, but has no apparent connection with the red zone in the stem. As the successive leaves are examined in order of age the discoloration recedes upwards, but has been seen frequently to retain at first a narrow connection with the base on the dorsal side. In the soft white central leaves, the petiole for a distance of from several inches to a foot from the base is usually normal in appearance, and then often contains an enclosed central infestation marked by vivid red and yellow spots and sometimes extending for two or three feet within the rachis."

"In the roots the visible effect of the disease is confined to the cortex, which consists of radial lamellae loosely packed into the region between the horny hypoderm and the central woody strand. This tissue is pure white and soft when healthy, but when infested it becomes dry and flaky and is discolored, first light yellow or pink, then dark yellow or reddish brown. Then infestation may extend from an inch or two to 10—12 feet from the point of attachment; it is continuous, and decreases in intensity in the outward direction. Infested trees vary very widely in the extent to which the roots are affected. A tree which is fully infested in stem and leaves may show only the very beginnings of infestation in the roots."

The inoculation experiments carried out in the West Indies prove conclusively that the infestation of the Coconut Palms by Nematode worms is the primary cause of the symptoms described

above. For our purpose three special features in the description given may be noted :—

(1) The shedding of green nuts in all stages of immaturity is in some cases the first external sign of trouble, though shedding of nuts from healthy trees often occurs.

(2) In the final stage a bacterial soft-rot of the Bud ensues, but there is no connection between this and infectious Bud-Rot disease.

(3) The internal symptoms show the tissues discolored dull-red or red mingled with mustard yellow; only in very exceptional cases the discoloration in the stem as a whole is central. The diseased zone usually forms a hollow cylinder enclosing healthy tissue inside.

The diseases in Malaya usually confused with Bud-Rot show well marked symptoms in the stems and roots. The sequence leading to the final appearance which results in the rotting of the Bud, appears to be a gradual loss of vitality, the crown grows sparse and thin and allows an easier entry of "Bud-rotting" organisms which completely disorganise the Bud-tissue. It was not until very careful attention was given that the true facts were observed, i.e. that the central leaves were attacked last, and on a few occasions specimens have been photographed showing all the outer leaves collapsed with the single central leaf remaining stiff and upright and the "Bud-tissue" still sweet and healthy. In true "Bud-Rot" the reverse is the case, the Bud-tissue and central leaves collapse while the older surrounding leaves still look green and healthy.

The observations made in Malaya on these obscure diseases may be best presented in chronological order. In 1921 a visit was made to the Bernam river district to inspect diseased Coconut trees. In past years "White-Ants" had given much trouble on the estate, and routine pumping with the usual White Ant smoke machine was in progress at the time of the visit. In addition to the "White Ants" the yield of nuts from the trees were decreasing, and cases of so-called "Bud-Rot" were frequent. The trunks of several trees were split from roots to crown and all showed similar symptoms, more or less advanced. All the felled trees had been attacked by White Ants in the past and the roots were dying off without showing particularly noticable symptoms. The stem tissues, while remaining soft and easy to section were noticably discolored a deep salmon pink colour, while patches of mustard yellow tissue were prominent intermingled with the salmon-pink tissue. The whole of the stem tissues in cross section were involved, the discolored tissue travelling up the stem in the typical "cone" characteristic of a slowly-progressing organism which had entered through the roots or at the base of the tree to progress upwards. The "Bud-Rot" was found only in advanced cases, when practically the whole of the stem tissues at the base were involved, the ascent of water thus being retarded or even wholly prevented.

The observations made were carefully checked but not a single tree could be found which did not show signs of White Ant attack.

The presence of " White Ants" prevented any definite conclusion as to the primary cause of the discoloration, and it was not until some eighteen months later that these symptoms were observed again on another estate in the same district. On this occasion no signs of White Ants could be found while the discolored tissues were exactly the same as in the case previously recorded. Since 1922, the disease has been reported from almost every Coconut growing district in Malaya.

Careful morphological work failedto reveal the presence of mycelium in the tissues but the appearances often strongly simulated the presence of Bacteria ; isolations from the infected tissue usually yield a white, glistening Bacterium, but inoculations with this organism have given negative results up-to-date.

The morphological examination of the diseased tissues had to be conducted carefully, for in fresh tissue, numerous vesicles simulating the appearance of various stages of an organism such as a *Spongospora* sp, were always present in the cells ; these vesicles, according to the usual micro-chemical reactions, were some atypical form of tannin, for while responding to most of the usual tests, there was no reaction with Potassium Bi-chromate. The conclusion was reached that these tannin vesicles were formed as a wound reaction ; this was tested while inoculating roots with a fungus which was suspected of causing a root disease. In all the wound inoculations and also the controls, these tannin vesicles were numerous in the region of the wounds but were absent in roots not wounded.

The symptoms approach those recorded by Nowell and given above. The internal discolorations seem to be much the same, but the difference in the distribution of the discolored portions is of large significance. In Red Ring disease of Coconuts the distribution is central in only very exceptional circumstances, where in the Malayan symptoms, the discolored tissue has been wholly central without exception. The discolored tissue from Malayan specimens has been carefully examined for presence of Nematodes but without success and it seems safe to say that Nematodes are absent. Falling of immature nuts is not a feature of the Malayan symptoms, and on these three counts it is fairly certain that some cause other than Nematode worms must be sought for.

Up-to-date, the disease in Malaya has been found only on trees over 10 years of age.

A very similar external appearance is presented by older trees, the stems of which, when split open, show very different symptoms to those given above. The sequence of events appears to be similar ; the leaves become smaller, the crown appears sparse and thin and often the top of the palm is blown off during high winds. When the tree is felled the wood is found to be so hard that much difficulty is experienced in keeping the axes in good condition. The wood is discoloured a dull-red with the vascular bundles showing up as deep brownish-red streaks. The disease travels from below upwards. If a tree is felled by cutting above ground level,

the tissue left uncut as the tree falls, stands up in a typical brush like arrangement owing to the tearing out of the abnormally liquified vascular bundles, which stand upright in a manner very similar to the bristles of a stiff brush. If the tree is cut early in the morning, a considerable amount of clear liquid oozes from the cut surface as though the vascular bundles were still actively functioning.

The abnormal lignification of all the tissues comprising the stem is remarkable; the lumen of the parenchymatous cells of the ground tissue being obliterated in advanced cases. Sectioning is almost impossible without delignification, which adds considerably to the difficulties of the investigation.

Most of the trees so affected are about 20 years of age, usually over 20 years. The disease progresses slowly but surely, and a typical case may be quoted. A small coconut garden kept for the benefit of servants and coolies has given 3000 nuts per annum for a considerable number of years; during the last three years no nuts at all have been obtained and two or three trees die per year and have to be felled. On another estate a patch of some eighty twenty two year old trees had to be taken out.

This disease has been reported from practically every Coconut growing district in Malaya. Careful examination has shown on two occasions that the soft rot described above is associated with abnormal lignification in parts; in one case the hardened tissue surrounded a central core of soft-rot tissue, and in the other the soft-rot tissue surrounded a central core of lignified tissue. This association renders the position still more complex, and considerable time is likely to elapse before much progress can be reported.

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" CONTRIBUTION TOWARDS OUR KNOWLEDGE OF THE ALEYRODIDAE OF CEYLON."

(*Concluded from our last issue.*)

Genus **Bemisia,** Quaintance and Baker.

Bemisia, Q. & B., Bur. Ent. U.S. Dept. Agr., Tech. Series 27, pt. 2, p. 99.

Bemisia emiliae, sp. n.

Pupa transparent yellow; situated on lower surface of leaf; slight waxy fringe present; in some specimens there is a pair of rather large, yellowish patches in subdorsal area at about the fourth abdominal segment; subovate; length 0 98 mm., breadth 0.68 mm. Margin crenulate, depressed in cephalo-thoracic region; a pair of small spines on anterior margin. Transverse suture distinct and abdominal segments evident. Tracheal folds present and covered with minute circular markings. On cephalothorax three pairs of spines (two pairs represented by their bases in fig. 8); behind transverse suture three pairs of minute spines, and in region of fifth abdominal segment another small pair; pores on dorsum not evident. Vasiform orifice typical of genus, triangular in shape; operculum subcordate, lingula exposed and armed with two spines; lateral margins of the orifice with conspicuous projections and mid-laterally a pair of spines; operculum and lingula setose. Caudal fold prominent; at its distal end a pair of prominent spines on tubercles and more laterally a pair of small setae.

Hakgala, on *Emilia sonchifolia,* v. 1912 (*E. E. Green*).

This species is separated from *religiosa* by having a transparent waxy fringe and by its dorsal spines not being so conspicuous, and from *leakii* by having spines on the dorsum.

Genus **Aleyrodes,** Latreille (1795).

Aleyrodes hyperici, sp. n.

Pupae rather inconspicuous on leaf, crowded together and of a light brown colour. Case elliptical in shape; length 0.94 mm., breadth 0.73 mm.; margin crenulate, more distinct posteriorly. Tracheal folds not discernible; cephalo-thoracic and transverse sutures distinct; abdominal sutures moderately prominent in mid-dorsal area. Vasiform orifice subcordate; operculum about half-filling the orifice; lingule exserted, setose and carrying a pair of spines at distal extremity. Pairs of small spines are situated on the anterior and posterior lateral margins, on cephalo-thoracic region near mid-dorsal line, near vasiform orifice at latero-anterior margin, on mid-lateral margin and a more prominent and more lateral pair behind these. In some specimens, posterior to the last pair of spines there is a pair of thickened chitinised plates or bases of spines.

Nuwara Eliya, on *Hypericum* sp. (*E. E. Green*).

Genus **Aleurocybotus**, Quaintance and Baker.

Aleurocybotus, Q. & B, Bur. Ent. U.S. Dept. Agr., Tech. Series 27, pt. 2, 1914, p. 101.

Aleurocybotus setiferus, Q. & B.

Aleurocybotus setiferus, Q. & B., Proc. U.S. Nat. Mus., li, 1917, p. 357.

This species was found in Java in 1907 on *Imperata* sp., and at Peradeniya, in 1913, on a grass. Green's specimens were collected at Peradeniya on *Imperata arundinacea*, iv. 1907.

Genus **Aleurocanthus**, Quaintance & Baker.

Aleurocanthus, Q. & B., *op. cit.*, 1914, p. 102.

Aleurocanthus citriperdus, Q. & B.

Aleurocanthus citriperdus, Q. & B., *op. cit.*, 1914, p. 102.

This species was taken by R. S. Woglum at Peradeniya, Ceylon, on an unknown tree, x. 1910, and also on *Citrus* in Java, i. and vii. 1911.

Aleurocanthus piperis, Maskell.

Aleurodes piperis, Mask., Ckll., Trans. New Zealand Inst, xxviii., 1896, p. 438.

This insect has been previously recorded from Ceylon on *Piper nigrum* (?). E. E. Green's specimens were collected on an unknown plant at Pundaluoya and on betel pepper (*Piper betle*) at Peradeniya, vii. 1909.

Aleurocanthus spiniferus, Quaintance.

Aleurodes spinifera, Q., Can Ent. xxxv, 1903, p. 68.

This Aleyrodid was recorded on *Citrus* sp. and rose from Java from material collected by C. L. Marlatt, xii. 1901. E. E. Green's specimens were obtained at Kandy, on rose leaves, v. 1907.

Aleurocanthus woglumi, Ashby.

Aleurocanthus woglumi, Ashby, Ann. Rept. Dept. Agr. Jamaica 1914—15, p. 31; Q. & B., Jl. Ag. Res. vi., 1916, p. 463.

This insect is widely distributed, having been recorded from the Philippines, Bahamas, Jamaica, Ceylon and India, and is found generally on *Citrus* plants. Other recorded hosts in Ceylon are *Capparis roxburghi*, *Capparis pedunculosus*, *Salacia reticulata* and *Kurrimia zeylanica*. Green's collections show that this insect is fairly prevalent in Ceylon, as they were obtained on undetermined plants at Colombo and Pundaluoya, v. 1909, and on a frond of a coconut palm (*Cocos nucifera*), at Haragama, v. 1909. There are variations in the

number of spines and in the size of the marginal teeth in these specimens as compared with the typical *A. woglumi* from Jamaica, but the general appearance of the pupa-case is so similar that to erect new species on such minor characters would not serve any useful purpose.

Aleurocanthus obovalis, sp. n.

Pupa obovate; length 0·94 mm.; breadth 0·70 mm.; margin dentate, with the teeth regular and rounded; a space of 0·1 mm. is occupied by 8-9 teeth. On the dorsum there is an irregular ring of eleven pairs of conspicuous spines, four pairs on the cephalo-thorax and seven pairs on the abdomen, the most anterior pair being the longest, whilst the sixth and seventh pairs are the shortest and arise nearest to the mid-dorsal line; in the mid-dorsal area of the cephalo-thorax there are three pairs of spines, the most anterior pair being very fine; posterior to the transverse suture there are probably three short spines, only the bases of which are discernible; anteriorly, latero-anteriorly and latero-posteriorly of the vasiform orifice arise other pairs of spines, the foremost of which is very short, whilst the last is very fine and long; on the anterior and posterior margins of the pupa-case a pair of spines is evident. An interrupted chitinised fold runs round the pupa-case in the submarginal area. Vasiform orifice subcordate, and the operculum similar in shape.

Pundaluoya, on a leaf of bamboo (*E. F. Green*).

This species may be distinguished from its near allies by its shape and by its having one row of conspicuous spines in the subdorsal area of the abdomen.

Aleurocanthus niger, sp. n.

Pupa black, with a slight white marginal wax fringe, subcircular with an octahedral appearance; length 1·87 mm., breadth 1·66 mm. Double margins present, exterior dentate with 6-7 teeth to 0·1 mm., interior about 0.05 mm. from outer margin and consisting of widely separated teeth which are variously rounded. Interior to the second margin, there is a ring of spines, the bases of which give the pupa-case the appearance of having a suture between the submarginal and subdorsal areas, the spines being arranged in regular formation. The details of the spines are difficult to follow, but there would appear to be nine pairs of long spines (three pairs on the cephalo-thorax and six on the abdomen) and 13 pairs of short spines, 11 pairs of which are situated on the abdomen; in the spaces between the spines are very small pores (spines). All these spines appear to have their apices slightly swollen, giving them a slightly vasiform appearance. The details of all the spines in the mid-dorsal area cannot be distinguished, but all apparently are hastate. The whole dorsum has a distinctly rugose appearance. On the anterior and posterior margins are pairs of small setae. The transverse suture, which extends to the margin, is distinct, so also are the sutures between the abdominal segments. Vasiform orifice subcordate, and with conspicuous projections on its inner and lateral margins.

Pundaluoya, on bamboo (*E. E. Green*).

Aleurocanthus nigricans, sp. n.

Pupa-case on leaf shiny black, with a narrow waxy marginal secretion ; no dorsal secretion evident ; sub-elliptical ; length 1 57mm., breadth 1 35 mm. Under the microscope the colour appears as dark brown, especially on the cephalo-thorax, where the characters are difficult to make out. Margin with a double row of teeth ; outer row with 6—7 teeth to 0.1 mm., inner row situated about 0.062 mm. from the margin. Transverse suture distinct to margin. Median ridge evident, especially in abdominal region. Surface of case rugose. In the submarginal area a ring of 63 spines present, which are frequently in groups of threes with a long spine separating each group, in which the anterior is the shortest and the middle one the longest. On the cephalo-thorax on each side of the median ridge short strong pointed spines are conspicuous. A pair of long spine, just posterior to the transverse suture and another anterior to ths vasiform orifice, these being swollen, almost hastate, at their apiece The long spines in the submarginal areas appear to be slightly hastate in form. Vasiform orifice on a prominent tubercle, subcordate, with posterior margin notched and with projections on inner and lateral margins ; the operculum fills the orifice.

Pundaluoya, on *Bambusa* sp. (*E. E. Green*).

The few specimens were badly preserved and were covered with a fungus, which made their examination difficult.

Genus **Aleurotrachelus**, Quaintance & Baker.

Aleurotrachelus, Q. & B., Bur. Ent. U. S. Dept. Agr., Tech. Ser. 27, pt. 2, 1914, p. 103.

Aleurotrachelus longispinus, sp. n.

Pupa on leaf glassy yellow in colour, with a fine waxy fringe and covered with white flocculent wax material. Ovate and slightly octahedral in shape, with the anterior margin pointed ; length 0.73 mm., breadth 0.41 mm. ; a well developed keel present. Margin with double row of teeth closely appcsed and difficult to differentiate ; outer row rounded and inner row more acute. The anterior end of median trachea-like ridge rather hastate. Transverse sutures to margin distinct. The anterior portion of pupa-case near the mid-dorsal line with three pairs of long spines, the hind pair being the shortest. Pairs of small spines are seen at the anterior and posterior lateral margins and a pair at the margin posterior to the vasiform orifice. Vasiform orifice almost subcircular with the posterior margin thickened and with a pair of long fronto-lateral spines almost reaching the margin ; operculum of similar shape, almost filling the orifice, and exposing the apex of the lingula, which is setose and carries a pair of spines.

Tellcola, xi. 1905, on an undetermined plant (*E. E. Green.*)

Genus **Neomaskellia**, Quaintance and Baker.

Neomaskellia, Q. & B., Bur. Ent. U. S. Dept. Agr. Tech., Ser., 27, pt. 1, 1913, p. 91.

Neomaskellia bergii, Signoret.

Aleurodes bergii, Sign. Ann. Soc. Ent. France, viii, 1867, p. 395.

Aleurodes sacchari, Maskell, Trans. N.Z. Inst. xxii, 1890, p. 171.

Quaintance & Baker received specimens of this insect from Zehntner collected in Java, ii. 1897, and also from Compère from Manila on wild grass. In the British Museum there are specimens from Samoa and San Thomé. In India, sugar-cane and juar (*Sorghum*) are recorded as host-plants.

Peradeniya; 18 v. 1910, on ribbed grass (*E. E. Green*).

Neomaskellia andropogonis, sp. n.

Pupa flat, pale yellowish in colour, without apparent secretion and found generally along the edges of the leaf; length 1.07 mm., breadth 0.62 mm.; elongate elliptical. Margin irregularly crenulate; marginal rim present. Sixteen pairs of spines on submarginal area; on both posterior lateral margin and cephalo-thorax a pair of inconspicuous spines. Abdominal segments distinct; simple pores numerous on the five abdominal segments anterior to the vasiform orifice; pores mostly confined to mid-dorsal area. Vasiform orifice not prominently elevated as in *bergii*, transversely elliptical with posterior margin thickened: operculum twice as broad as long, about half-filling the orifice, and slightly attenuated at the junction of the lateral and posterior margins; lingula short, broadly rounded and setose; spines on lingula not evident. Vasiform orifice with a pair of short spines mid-laterally, and in some specimens a pair of chitinised thickenings or spines latero-posteriorly.

Bandarawalla, on *Andropogon* sp., v. 1906 (*E. E. Green*).

Genus **Aleurolobus**, Quaintance and Baker.

Aleurolobus Q. & B., Bur. Ent. U.S.A. Dept. Agr. Tech. Series 27, pt. 2, 1914, p. 158.

Aleurolobus flavus, Q. & B.

Aleurolobus flavus, Q. & B., Proc. U. S. Nat. Mus. li, 1917, p. 360.

Peradeniya, on unknown tree, x. 1910 (*R. S. Woglum*); on *Loranthus* sp. 26. v. 1913 (*A. Rutherford*); and one specimen found on the leaf of *Loranthus* with the gall-forming *Dialeurodes loranthi* collected at Hewheta, viii. 1910 (*E. E. Green*)

Aleurolobus setigerus, Quaintance & Baker.

Aleurolobus setigerus, Q & B, Proc. U.S. Nat. Mus. li, 1917, p. 372.

Peradeniya, vii. 1913, on *Harpullia pendula*, and ix. 1913, on *Harpullia* sp. (*A. Rutherford*).

Aleurolobus zeylanicus, sp. n.

Pupa on leaf dense shiny black and raised by the submarginal area forming a rim. White waxy fringe present in some specimens; obovate; length 0.86 mm., breadth 0.35 mm. Margin crenulate, three prominent teeth present at each tracheal fold. In the submarginal area there is a ring of 14 pairs of long, fine hairs, and external to this an irregular row of inconspicuous spines, dark brown circular markings are numerous; submarginal suture distinct. On subdorsal area are numerous dark brown pores in irregular chain formation, and throughout the dorsal area pores of a compound nature are evident. Sutures between abdominal segments fairly distinct and the transverse suture almost reaches the submarginal suture. About twelve pairs of pores on the subdorsal area, eight pairs being situated on the abdominal segments. Vasiform orifice situated on a tubercle, and subcordate in shape. A pair of reniform eye-spots present. A pair of fine spines near anterior margin of cephalo-thorax and another pair latero-anteriorly to the vasiform-orifice.

Trincomali, v. 1906, on an unidentified plant (*T. B. Fletcher*).

Aleurolobus greeni, sp. n.

Pupa on leaf dark brown to shiny black, without an apparent wax fringe, though in the younger stages a faint fringe of yellowish wax may be discerned. Broadly elliptical: length 1.11 mm. breadth 0.94 mm.; margin double, both dentate with square edges; posterior lateral margin with a pair of small spines; on submarginal area, sutures running in from margin conspicuous. A row of small spines in groups of twos runs right round the submarginal area. Tracheal and caudal folds conspicuous and terminating in a single large tooth. Tracheal pores very distinct, being rounded in shape and sculptured with polygonal markings. Submarginal suture about 0·11 mm. from margin. Transverse and abdominal sutures wavy and distinct. Dorsal area uniformly dark brown. Eye-spots reniform and transparent. On the cephalo-thorax there are six pairs of dark markings and on the abdomen seven pairs, five of them situated on the subdorsal region and two pairs posterior to the transverse suture on the mid-dorsal area. From the centre of each of these dark spots arises a small spine. The surface of the dorsal disc is sculptured and the margin incised. No conspicuous spines on dorsum. Vasiform orifice somewhat triangular, longer than broad, and the lateral margins with projections; operculum subcordate, filling about two-thirds of the orifice, leaving the lingula exposed. The orifice is surrounded by a trilobed area, the lateral arms of which do not reach the margin.

Peradeniya, xi. 1905, on an undetermined shrub (*E. E. Green*).

Genus **Tetraleurodes**, Cockerell.

Tetraleurodes, Ckll., Fla. Agr. Exp. Sta., Bull. 67, 1903, p. 664.

Tetraleurodes rugosus, sp. n.

Pupa on leaf black, with well developed wax fringe and dorsum covered with wax of a flocculent nature; oval in shape; length 1·52 mm., breadth 0·11 mm. Margin double, outer margin rather more distinctly crenulated than inner; anterior and posterior lateral margins each with a pair of spines. Tracheal and caudal folds represented by one tooth, caudal tooth more conspicuous. Inside the margin there is a ring of small pores (hairs), and interior to this a row of 13 pairs of short spines near the submarginal suture. The dorsum, with the exception of the submarginal area, rugose in appearance and the abdominal sutures appearing black against dark brown corrugations; medio-dorsal and transverse sutures distinct. Eye-spots reniform. Small setae occur on the dorsum, especially on cephalo-thoracic region. Vasiform orifice small and subcircular.

Dambula, 30. viii. 1910; Maha Illupalawa, North Coast Prov., ix. 1905, on grass (*E. E. Green*).

Tetraleurodes semilunaris, sp. n.

Pupa on leaf with powdery wax fringe; under the microscope dark brown; elliptical; length 1.52 mm., breadth 0.90 mm. Margin crenulate; on the submarginal area there are about 66 pairs of conspicuous semilunate pores, each of which has about eleven divisions; just internally to these pores, a row of small pores (spines) and then a regular ring of about 15 pairs of spines. Submarginal suture distinct, as also are the dorso-median, transverse, and abdominal sutures; the transverse suture turns slightly anteriorly and reaches the submarginal suture; abdominal sutures with conspicuous thickenings. Throughout the derm are small spines, the most conspicuous being a pair on the cephalo-thorax, a pair posterior to the transverse suture, and a pair beside the vasiform orifice. Vasiform orifice subcordate; operculum filling about two-thirds of the orifice; lingula exposed, setose and armed with two long hairs at its distal end. A distinct furrow running from the lateral anterior margins of vasiform orifice to the submarginal suture.

Colombo. xi. 1903, on citronella grass (*Cymbopogon* sp.) (*E.E. Green*).

GENUS **Zaphanera,** NOV.

Pupa-case with a double row of marginal teeth; submarginal area not separated from dorsal disc; thoracic and caudal folds indicated but not distinct; rhachis prominent and abdominal sutures distinct; cephalo-thorax with a well-defined median area; no prominent setae on dorsum but small circular pores present; vasiform orifice elevated, subcordate, filled by operculum, lingula obscured.

Genotype, *Zaphanera cyanotis*, sp. n.

Near to *Aleurotrachelus*, Q. & B., but differing in the presence of dorsal pores, and the elevated vasiform orifice.

Zaphanera cyanotis, sp. n.

Pupa on leaf shiny black, with white marginal fringe and pronounced white wax secretion along mid-dorsal line. Length 1.48 mm., breadth 1.01 mm.; ovate with slight constriction in the region of the thoracic folds. Margin double, with outer edge more conspicuously dentate; a row of small pores runs round the margin of the pupa-case; interior to this row and within the light brown portion of the case, there is a row of five or six small pairs of pores, one pair situated at the thoracic folds. Thoracic folds indicated by the depressions at the margin and by slight waxy sutures running inwards from the margin. The caudal fold made prominent by its lighter colour, the margin at its termination slightly protruding and armed with two long spines. Transverse and cephalo-thoracic sutures distinct. Demarcated area in cephalo-thorax with about seven pairs of small pores: reniform eye-spots present; a dark brown area, composed of dark brown irregular circular spots, is conspicuous between the light brown marginal area and the rhachis. Rhachis very prominent, and there are rows of small pores situated subdorsally and mid-dorsally. Beside the rhachis a row of small pores may be seen and also near the marginal area. The abdominal sutures with chitinised thickenings. Vasiform orifice subcordate, with a pair of spines latero-anteriorly and a prominent pair latero-posteriorly. A pair of small setae may be seen at the latero-anterior and latero-posterior margins.

Maskeliya, v. 1911, on *Cyanotis* sp. (*J. Pole*); Pundaluoya, on *Cyanctis* sp. (*E. E. Green*)

GENUS **Laingiella**, NOV.

Pupa-case of medium size, fringed; margin with a double row of teeth; sub-marginal area with wax tubes well developed and not separated from sub-dorsal area; dorsal area with small compound pores; tracheal and caudal folds absent; vasiform orifice elevated, well filled by operculum, subcordate, lingula included.

Genotype, *Laingiella bambusae*, sp. n.

This genus would appear to have affinities with *Paraleyrodes*, Quaint, but may be distinguished from it by the double row of marginal teeth and by the difference in shape of the vasiform orifice and lingula.

Laingiella bambusae, sp. n.

Pupa on leaf black and made conspicuous by its white fringe. Length 0.99 mm., breadth 0.74 mm.; elliptic in outline. Margin with a double row of teeth, the outer margin more prominent; sub-marginal area differentiated from the sub-dorsal area by a ring of seemingly transverse linear lines (thickened terminations of the sutures of the wax tubes) this ring being about 0.17 mm. from the margin. The sutures at the vasiform orifice are distirct and do not reach the margin. An uneven toothed line runs round the pupa-case

at about 0.06 m.m. from the margin and up to this line the sutures from the margin are very distinct; on each side of these sutures dark brown markings are evident. An interrupted thickened chitinised fold runs round the pupa-case between the margin and the line of demarcation caused by the sutures. There are nine pairs of small compound pores forming a ring in the sub-dorsal area; anterior to the transverse suture there are two more pairs of the same size, and anterior to these a smaller pair. In addition to the above-named pores, six pairs are situated on the dorsal ridge. Smaller inconspicuous pores may be seen on the dorsum. A pair of spines on the anterior and latero-posterior margin, a pair on the cephalo-thorax, four pairs latero-anteriorly of vasiform orifice, and one pair posteriorly on the sub-marginal area. The vasiform orifice subcordate; operculum filling the orifice and obscuring the lingula.

Ratnapura, on bamboo, 5.x.1909 (*E. F. Green*).

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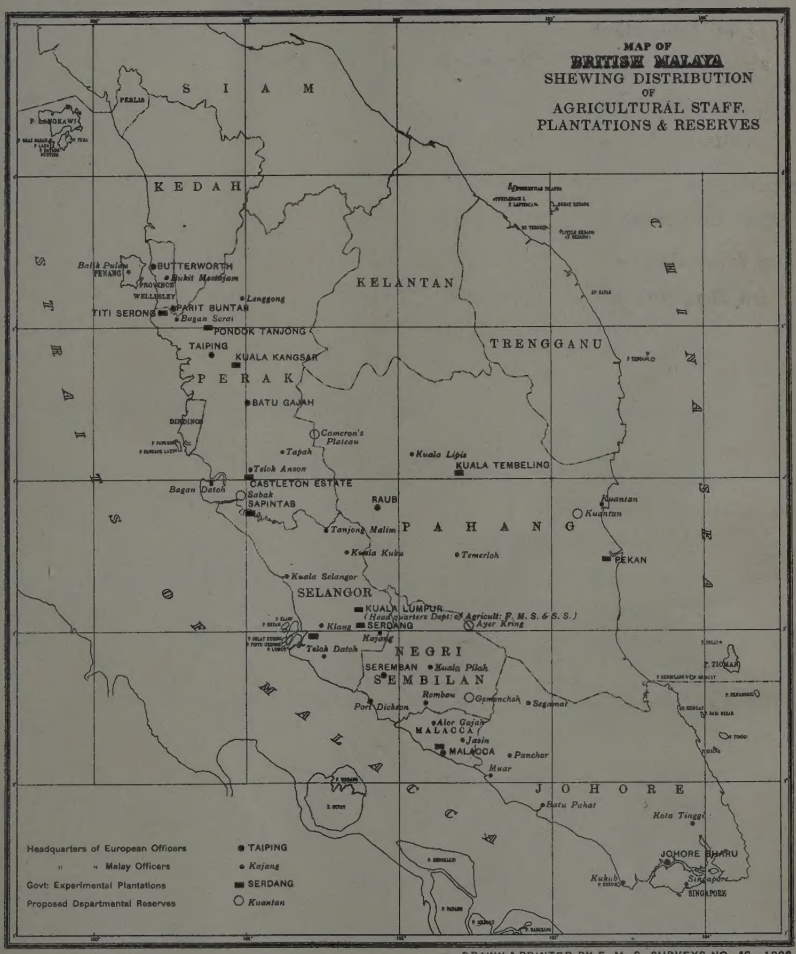

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